**MTH 160 STATISTICS I (revised 10/14/11 effective Spring 2012)**

The purpose of this course is to introduce the student to Statistics in a way that will make the student aware of the techniques of Statistics as they apply to the solutions of practical problems in various fields. This introduction will be presented with particular attention to statistical vocabulary; interpreting statistical formulas and graphs; and representing statistics symbolically, visually, numerically, and verbally.

The individual instructor is required to prepare and administer a comprehensive final exam.

1. Descriptive Statistics
   - 1.1 Define the terms population, sample (large and small), statistical experiment, variable (discrete and continuous), data (qualitative and quantitative), statistic, and parameter.
   - 1.2 Define and use simple random sampling techniques.
   - 1.3 Explain why the mean, median and mode are examples of statistics which are measures of central tendency, and calculate these measures to describe data using appropriate formulas and technology.
   - 1.4 Explain why the range, variance, and standard deviation are examples of statistics which are measures of variation (dispersion) and calculate these measures to describe data using appropriate formulas and technology.
   - 1.5 Explain why the standard scores (z-scores), quartiles, and percentiles are measures of position and calculate these measures to describe data.
   - 1.6 Explain what grouped and ungrouped frequency distributions are and construct these to represent large samples.
   - 1.7 Construct a histogram and a box-and-whiskers display with or without technology to represent data and use these to interpret and draw inferences about the data. Graphs such as a stem-and-leaf display, ogive, bar graph, dotplot, circle graph (pie chart) and Pareto diagram are optional.
   - 1.8 Describe the characteristics of the following distributions: normal, uniform or rectangular, skewed, and bimodal.
   - 1.9 Use the following three major features of interest to describe, interpret, and draw inferences about the distribution of a sample or population:
     - a. shape (pattern of variability)
     - b. central tendency
     - c. dispersion
   - 1.10 Explain the Empirical Rule and use it to draw inferences about a sample or population.

2. Correlation and Regression
   - 2.1 Define the terms bivariate data, data point, scatter diagram, correlation coefficient (r), regression line, and regression coefficients, and explain the method of least squares.
   - 2.2 Explain what correlation and regression are, why these methods of analysis are performed, and their limitations.
   - 2.3 Given a set of bivariate data, with or without technology:
     - a. Construct a scatter diagram and use it to interpret and draw inferences about the data.
     - b. Calculate the linear correlation coefficient (r) and use it to interpret and draw inferences about the data.
     - c. Calculate the equation of the least squares regression line, graph it on the scatter diagram, and use it to interpret and draw inferences about the data.
   - 2.4 Estimate a reasonable value for r given a scatter diagram.

3. Probability
    - 3.1 Define the terms probability, simple probability experiment, sample space, simple event, compound event, complement, mutually exclusive, dependent, independent, and conditional probability.
    - 3.2 Calculate the probabilities of simple and compound events using relative frequency.
    - 3.3 Apply the addition, multiplication, and complement rules of probability when appropriate.

4. Discrete Probability Distribution
    - 4.1 Describe what a random variable is (both discrete and continuous).
    - 4.2 Represent a discrete random variable by constructing a discrete probability distribution.
    - 4.3 Construct, with or without technology, a histogram to represent a discrete probability distribution.
    - 4.4 Given a discrete probability distribution, calculate and interpret probabilities for the associated discrete random variable.
    - 4.5 Calculate the mean to describe the expected value of a discrete random variable.

5. Binomial Probability Distribution
    - 5.1 Describe the characteristics of a binomial probability experiment.
    - 5.2 Determine whether a variable is or is not a binomial random variable.
    - 5.3 Explain why a binomial random variable is an example of a discrete random variable.
    - 5.4 Explain that the parameters of the binomial distribution are n and p and that the possible values of the binomial random variable are the integers from zero to n, inclusive.
    - 5.5 Calculate probabilities for a binomial random variable using at least one of the following: binomial formula, binomial probability table, Minitab.
    - 5.6 Use the addition and complement rules to calculate and interpret probabilities for multiple values of a binomial random variable.
    - 5.7 Calculate $\mu$ and $\sigma$ to describe a binomial probability distribution using the appropriate formulas.

6. Normal Probability Distribution
    - 6.1 Explain why a normal random variable is an example of a continuous random variable.
    - 6.2 Use the Standard Normal Distribution table to:
        - a. Calculate the area under the standard normal curve for given values of z
        - b. Determine z for a given area under the standard normal curve
    - 6.3 Explain why $\mu$ and $\sigma$ are the parameters of the normal probability distribution and explain its properties:
        - a. the mean equals the median
        - b. symmetry about the mean
        - c. total area beneath curve is 1
        - d. satisfies Empirical Rule
    - 6.4 Given $\mu$ and $\sigma$ for a normal random variable, represent associated probabilities by using:
        - a. a sketch of the normal curve and shading the appropriate area
        - b. mathematical symbols and numbers; e.g. $P( x > 115 )$
        - c. a written statement
    - 6.5 Use the Standard Normal Distribution table to:
        - a. Calculate probabilities for given values of a normal random variable
        - b. Determine values of a normal random variable for given probabilities

6.6 Interpret the area under a normal curve over an interval both as the probability that the value of a normal random variable is in the interval and as the proportion of a normally distributed population that is within the interval.

7. Sampling Distribution

7.1 Explain what a sampling distribution is and the method to approximate one for any sample statistic.

7.2 Explain the Central Limit Theorem and use it to describe the properties of the sampling distribution of the sample mean, $\overline{x}$ .

7.3 Calculate (or approximate) and interpret probabilities for values of a sample mean, $\overline{x}$ .

8. Statistical Inference - Estimation and Hypothesis Testing

8.1 Describe the relationship between a sample statistic and its corresponding population parameter.

8.2 Explain the estimation method and define the terms point estimate, level of confidence, maximum error of estimate, and confidence interval.

8.3 Explain the hypothesis testing method and define the terms null hypothesis, alternative hypothesis, level of significance, Type I error, Type II error, test statistic, p-value, decision and conclusion.

8.4 Describe the Student's t-distribution and compare it with the normal distribution.

8.5 Using both z and t as appropriate, construct and interpret confidence intervals that estimate μ and p for any level of confidence. Recognize the limits of the methods used to construct these estimates.

8.6 Generate the following hypothesis tests and interpret the decisions with appropriate conclusions that incorporate the limits of these tests:

a. test μ (using both z and t as test statistics)

b. test p (using z as the test statistic)

9. Statistical Project

Demonstrate in at least one project the understanding that statistics is the study of how to collect, organize, analyze, interpret, and represent numerical data. Project components may be done by hand and/or using Minitab. An <u>example</u> of a project:

- Collect at least 30 pieces of data.
- Organize the data by constructing a frequency distribution.
- Calculate statistics such as the mean, median, mode, range, percentiles, and quartiles and use these to interpret and draw inferences about the data.
- Represent the data visually using a histogram and/or a box-and-whiskers display.
- Interpret the data with respect to Empirical Rule and/or Chebyshev's Theorem.
- Present all of the above in a neat and accurate form.

10. Statistical Computer Software (Minitab)

*Use Minitab to produce and print the following:

10.1 At least a histogram <u>and</u> a box-and-whiskers display for univariate data.

10.2 Descriptive univariate statistics including at least: mean, median, mode, range, variance, and standard deviation.

10.3 A scatter diagram to represent bivariate data.

10.4 The correlation coefficient (r) and the linear regression equation for bivariate data.

10.5 A confidence interval to estimate the mean.

10.6 A hypothesis test for the mean.

*The instructor is encouraged to use additional Minitab commands and/or menu choices.